NUTRITION PRACTITIONER'S PERSPECTIVE OF THE NUTRITION KNOWLEDGE AND BEHAVIORS OF PREGNANT PATIENTS

A Thesis
by
SYDNEY NICOLE VAN SCYOC

Submitted to the Graduate School
Appalachian State University
in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE

May 2020
Department of Nutrition and Healthcare Management

NUTRITION PRACTITIONER'S PERSPECTIVE OF THE NUTRITION KNOWLEDGE AND BEHAVIORS OF PREGNANT PATIENTS

A Thesis
by
SYDNEY VAN SCYOC
May 2020

APPROVED BY:

_____

Danielle Nunnery

Chairperson, Thesis Committee

_____

Alisha Farris

Member, Thesis Committee

_____

Manan Roy

Member, Thesis Committee

_____

Margaret Barth

Chairperson, Department of Nutrition and Healthcare Management

_____

Michael McKenzie

Dean, Research and Graduate Studies

Foreword

This manuscript is formatted to reflect the requirements of submission to the *Journal of Maternal and Child Health*.

Abstract

NUTRITION PRACTITIONER'S PERSPECTIVE OF THE NUTRITION KNOWLEDGE AND BEHAVIORS OF PREGNANT PATIENTS

Sydney Nicole Van Scyoc
B.S., Ouachita Baptist University
M.S., Appalachian State University

Chairperson: Danielle Nunnery

Women are more aware of nutrition during pregnancy, but what nutrition information do they receive from their healthcare team and is it effectively delivered? The objective of this study was to assess these questions from the lenses of nutrition professionals who provide nutrition education to this vulnerable population. North Carolina nutrition professionals (N=73) working with pregnant women completed an online survey about their provision of nutrition services to pregnant clients. Respondents reported their clients both need and request information on general healthy nutrition for pregnancy and lactation, and appropriate weight gain. Cost and lack of time to cook were perceived as influential barriers facing pregnant women who want to make dietary changes. Pamphlets, posters, texting and telehealth counseling were cited as feasible education materials for practitioner use. Educational interventions designed for rural pregnant women should teach general healthy nutrition and appropriate weight gain while providing guidance on time and cost-efficient approaches. When possible, delivering information through technology could be an effective, convenient way for nutrition professionals to engage clients.

Acknowledgements

Firstly, I must thank my undergraduate nutrition faculty at Ouachita, Dr. Detri Brech and Mrs. Stacy Freeman, who together made our small department an excellent and rewarding place to learn. To the nutrition department at Appalachian State, studying here under you all has been the most unexpected joy. Danielle Nunnery deserves special thanks for being a source of advice, encouragement, and a great role model as I enter the dietetics field. Thanks to the additional members of my thesis committee, Manan Roy and Alisha Farris. Lastly and most importantly, thanks to my wonderful parents, Tim and Dee Ann Van Scyoc. Without your advice and encouragement, my lifelong passion could never have transformed into a fulfilling career. I love you both.

Table of Contents

Abstract……..iv

Acknowledgements……v

Forward……vii

Chapter I Introduction 1

Chapter II Literature Review 3

Chapter III 14

Introduction 15

Methods 20

Results 22

Discussion 25

Limitations 27

Conclusion 28

Chapter IV Epilogue 30

References 32

Appendix 35

Vita 48

Chapter I Introduction

In order to address inadequate nutrition status and diet quality among American pregnant women, it is necessary to discover what pregnant women know about their nutrition needs, where they get their information, and barriers they face in making nutrition related health changes. Gaining insight on these topics from a nutrition care provider's viewpoint could help to expose gaps in nutrition knowledge and care and identify needs for effective nutrition education materials. Much of the existing literature examining nutrition education and knowledge barriers among pregnant women is out of date, was performed in other countries, or surveyed only primary care physicians (PCPs). This study attempts to fill a gap in current literature on nutrition education in pregnancy by surveying nutrition professionals on what information is needed and what barriers exist that prevent women from receiving the best possible nutrition care.

Nutrition education and counseling is essential for filling knowledge gaps and influencing birth outcomes. Pregnancy is a time when women visit their physicians regularly for prenatal appointments. These appointments are an ideal avenue for nutrition education and counseling. However, little is known about the content of nutrition advice that PCPs and OBGYNs provide their patients, or the barriers that may prevent them from doing so. It is important to determine what information women need and want to learn during nutrition counseling if and when they are able to see a nutrition professional. Before nutrition education programs and initiatives can be developed for pregnant populations, more research must be conducted as to the amount and content of nutrition advice currently received by this population.[1] For example, what kind of nutrition information are women seeking during pregnancy, and what sources do they use? Even if women have access to reliable nutrition education and counseling, there may be barriers to their application of this knowledge. Few

studies of this kind have been previously conducted. The goals of this study are to 1) assess the amount of time spent and types of resources used by professionals when providing nutrition education, 2) determine professionals' perception of the nutrition behaviors and knowledge of pregnant patients, and 3) determine what education materials professionals use currently, and what materials they believe would be feasible for and acceptable to their patients. The results of this study are intended to inform and guide the development of future educational materials and interventions among pregnant women in North Carolina.

Chapter II Literature Review

The key to prevention of chronic disease and obesity risks may begin in prenatal health and nutrition care. The Life Course Theory (LCT) is a framework that goes beyond biology to explain an individual's health status by accounting for every possible determinant of health.[1,2] The purpose of the theory is to predict and prevent the incidence of disease among populations over time by viewing individuals within the context of their physical, social, socioeconomic, and environmental contexts.[3] The timing of influential events, especially early life factors, are hypothesized to have significant effects on chronic disease risk and health in later life. These early life factors include the fetal environment. The World Health Organization has recognized the LCT framework as key to understanding health across the life span beginning with preconception and maternal care.[4] This provides justification for targeting prenatal and maternal health interventions to prevent development of chronic disease across the lifespan.

The Barker hypothesis was one of the first to suggest that maternal nutrition, among other factors, during the gestational period had a lasting impact on offspring health and disease risk.[2] Early retrospective epidemiology studies have supported this hypothesis by drawing correlations between maternal malnutrition and incidence of disease for children in later life.[5,6] These studies observed that maternal undernutrition and likely deficiency of many nutrients was related to low birth weight, intrauterine growth restriction, and eventual occurrence of cardiovascular disease, stroke, type two diabetes, obesity, dyslipidemia, hypertension, and cognitive disorders in offspring.[5,7,8] In the beginning stages of research, the biological mechanisms driving these outcomes were unknown. Recent research points to the concept of epigenetics to explain these biological mechanisms.

Fetal Programming is the idea that environmental, metabolic, and nutritional disruptions during critical periods of gestation can negatively affect the development of fetal organs, metabolic, and epigenetic processes.[9] Epigenetics include any mechanism whereby environmental stimuli and stress can alter an organism's gene expression. The most popular mechanism proposed for fetal epigenetic changes in gene expression and DNA methylation.[10] Current research implies that epigenetic alterations, specifically histone metabolism and DNA methylation, are at least partially responsible for fetal programming.[10,11] Epigenetics alterations are the programming effects of heritable traits and genetic expressions that are independent from DNA sequencing.[11,12] Clearly maternal diet has lifelong effects on offspring gene expression and potential susceptibility to chronic disease in adulthood.

Consequences of folic acid or choline deficiencies, which serve as methyl donors, are evidence that DNA methylation disturbances are one mechanism of epigenetic programming.[11,12] DNA methylation is integral to genomic imprinting, transcription, and embryonic development. Two causes of changes or disruption in DNA methylation that adversely influence gene expression are nutrition and fetal environment stressors. Folate is essential to healthy development of the brain and nervous system during pregnancy and acts as a methyl donor for DNA and RNA. Folate deficiency causes birth defects and altered cognitive function in offspring.[11] Learning and memory disabilities, inhibited motor coordination, intrauterine growth retardation, and low academic success have been correlated with low folate even when diet is later corrected and sufficient. Folate supplementation, along with B12, is recommended for all women of childbearing age.

The consequences of maternal undernutrition during famine are well documented, but inadequate diet or nutrient deficiencies still affect women and babies even when starvation or

malnutrition are not present. Undernutrition during critical periods of fetal growth may lead to altered organ function, homeostatic mechanisms, and low birth weight. Measurements at birth such as weight, length, and body proportion are strongly related to the later risk for or development of chronic diseases including cardiovascular disease and diabetes.[8,13] Inadequate dietary intake or variety can determine factors of fetal adipose tissue like levels of UCP1 (an uncoupling protein in brown adipose tissue) or leptin which may result in reduced fat tissue deposition. Such endocrine adaptations in children who were nutrient deprived in utero result in increased obesity risk.[13] One study among obese adult women who had reduced fetal growth before birth discovered that they experienced exacerbated risks for heart disease including high blood pressure, insulin resistance, high serum triglycerides, and low high-density lipoprotein concentrations.[5] While undernutrition and nutrient deficiencies cause negative epigenetic changes, overnutrition and its related complications are equally undesirable.

High adiposity in the mother fosters the same undesirable outcome in her offspring which occurs during development via heightened intramuscular adipogenesis. Excess weight may be influenced greatly by maternal nutrition status and could predispose infants to obesity, type 2 diabetes, insulin resistance, and cardiovascular disease in adulthood.[9,10] An increasing number of non-pregnant women of reproductive age are obese, placing them in a low-grade inflammatory state. Past studies have recorded a buildup of macrophages with increased expression of inflammatory cytokines in the placentas of obese women.[14] Inflammation secondary to obesity during pregnancy creates a pro-inflammatory in utero environment which may result in future fetal obesity and insulin resistance. Specific conditions in pregnancy other than obesity, like pre-eclampsia and gestational diabetes, exacerbate the inflammatory state.

Maternal glucose intake and regulation affects infant birthweight via mechanisms of glucose transfer from maternal blood through placenta as glucose is the primary fuel for placenta and fetus.[7] Hyperglycemia in early gestation upregulates placental glucose transporters and results in excessive fetal growth. This causes placental cells react in a way that constricts blood vessels and inhibits blood flow, increasing fetal risk of future hypertension.[9] Possible complications of gestational diabetes include macrosomia, miscarriage, neonatal hypoglycemia, and congenital malformation, but careful glucose control with medical nutrition therapy can decrease likelihood of these complications.[15]

Because nutrition plays such a huge role in fetal development and outcomes, it is important to invest in prenatal and maternal care. Research has indicated that women who are trying to conceive or are already pregnant are more aware of their diets and are motivated to make healthy behavior changes for the sake of their children.[16,17] This time of willingness to learn and apply health knowledge is advantageous for health professionals and should be applied in practice. Future interventions in nutrition education and counseling should begin with an assessment of women's diet and health behaviors during pregnancy. What do women know, where do they get their information, and are they able to apply this knowledge?

Overweight and obesity are prevalent among women of reproductive age, as they are with all Americans.[18] Optimal nutrition and weight status is important prior to conception, as it prevents and lowers risk of developing a multitude of health complications. Pre-pregnancy BMI influences gestational weight gain for over and underweight women. Gaining an appropriate amount of weight during pregnancy as per the Institute of Medicine guidelines is influenced in part by maternal nutrition.[18] The Institute of Medicine (IOM) published weight gain guidelines for each trimester according to pre-pregnancy weight status in 2009.[19]

A cross-sectional study from 2017 found that 75% of overweight women were unaware of weight gain or nutrition guidelines during pregnancy.[16] Awareness of the complications of excessive maternal weight gain was also low, as was the number of women who believed nutrition to be a key part of weight management. Maternal obesity rates and lack of understanding or awareness of weight gain guidelines set by the IOM continue to rise. Healthcare providers must recognize and address this knowledge gap to educate and encourage proper maternal nutrition and weight management.

Changes in maternal nutrient needs during pregnancy increase slightly by trimester.[18] Energy needs do not increase until the second and third trimesters, by 340kcals/day and 452kcals/day accordingly. Protein needs increase by 25g daily. Iron and zinc needs are needed in almost twice the usual DRI amount. Fiber, some minerals, and vitamins A, Bs, and C increase as well. Calcium DRIs do not change with pregnancy, but many women do not have adequate calcium stores or intakes. NHANES data prior to 2008 indicate low levels of vitamin E, potassium, fiber, and magnesium in women of childbearing age. To overcome this, vegetables, fruits, and whole grains must be encouraged.[16]

Nutrients of special concern include folate, omega-3 fatty acids, calcium, vitamin D, and iron.[16] Folic acid supplementation is recommended at 4g/day for women of reproductive age, as dietary folate is not as bioavailable. Supplementation of n-3 LCPUFAS has lowered risk of preterm birth and heightened gestational length. Iron deficiency is common among minority women and low-income women, who are also less likely to supplement. Adequate calcium reduced risk for hypertensive disorders. Low dose iron supplementation (30mg/day), and heme iron food sources are recommended to improve maternal and fetal iron stores. Vitamin D deficiency is associated with gestational diabetes, pre-eclampsia, low birth weight, and preterm

delivery.[20] Additional special concerns for pregnant populations include vitamin A toxicity, mercury poisoning, substance abuse, and foodborne illness.[20]

A systematic review and meta-analysis compared intakes of pregnant women compared with micronutrient recommendations from multiple countries.[21] Even in developed countries, multiple factors place women at risk for nutrient deficiency, malabsorption, or even excess intake. Studies including intake of nutrients via supplements were excluded. The Estimated Average Requirement (EAR) was used when comparing actual intake to prevalence of inadequate intake among American pregnant women. Vitamin A and B vitamins, except for folate, were all at or above recommended levels. Key nutrients below national standards in American women were folate (64% of EAR), iron (72% of EAR), and vitamin D (43% of EAR) even when controlled for socioeconomic status. Similarly, women of childbearing age who were not pregnant had low intakes of these nutrients: folate (55%), iron (45%), vitamin D (58-75%). Folate supplementation to prevent neural tube defects is recommended before conception and during the first trimester. Women should be educated and encouraged to begin a healthy dietary pattern before conception.

A systematic review evaluated changes in fruits and vegetables, sweet foods, fast and fried foods, beverages, and energy and macronutrients intakes among pregnant women.[21] Most participants reported significantly increased intake of dairy, fruits, and vegetables during pregnancy. Only one study found that women ate an increased amount of sweets during early and late pregnancy. Two articles indicated no difference in fried food intake, but a decrease in fast food intake. Sugary beverage consumption decreased during pregnancy, but women who had high consumption of these beverages had low intakes of fruits and vegetables. Four of five

studies noted increased energy intake, and the other reported no change. Women who made dietary changes tended to be older and more educated.[21]

There are disparities among subgroups of pregnant women who are able and willing to make healthy diet changes. In a study of the difference in diet quality and composition of pregnant women according to race, ethnicity, and education level, Healthy Eating Index scores were below recommendations for women of all races and education levels.[22] Intakes of "empty calories", foods with added sugar, solid fats, or alcohol, accounted for 34% of women's daily energy intake. Iron, folate, and vitamin C sources were mainly enriched grains and juices. Diet quality for Hispanic and non-Hispanic black women and women with less than a college degree was particularly low. Because these populations have been identified as at risk, nutrition education may help to improve diet quality and, therefore, birth outcomes among these women.

Many variables affect nutrition status in pregnant women. However, they are rarely participants in national nutrition surveys, and few studies of American pregnant women's nutrition status exist.[22] This makes understanding and assessing their diet quality very difficult. The current literature implies that diet quality and nutrition status among pregnant women in the United States is not adequate and may be contributing to a number of pregnancy and birth complications. A potential explanation for this is that pregnant women do not have access to reliable nutrition education and information. Multiple studies have indicated that women lack adequate knowledge of nutrition needs during pregnancy. Pregnancy is a time that influences and motivates women to make health, behavior, and dietary changes.[22,23] Though women are generally more aware of nutrition during pregnancy, they may lack the resources to obtain reliable information or encounter significant barriers to making healthy changes.

A 2014 survey found that one fourth of pregnant women get their nutrition information from the internet.[16] Some participants noted that healthcare providers assumed that multiparous women already had the knowledge they needed simply because they had experienced pregnancy before. In a questionnaire administered by Blondin and LoGiudici, 25% of women reported feeling inadequately educated on diet during pregnancy and didn't always trust the information they researched online.[16] This was especially true among women in their first pregnancy. Some participants noted that healthcare providers assumed that multiparous women already had the knowledge they needed simply because they had experienced pregnancy before. Authors suggest that providers list reputable, helpful websites on any education materials given to pregnant women and emphasize that internet-based strategies would be helpful. In a clinical setting, approximately 5 minutes could be used to go over a handout and answer patient questions and be beneficial to pregnant women. If such services were billable, this would be more likely implemented in clinical settings.

Women become more interested in nutrition and health behaviors when they are trying to conceive and once they are pregnant, particularly during the first trimester.[23] A cross-sectional study among Dutch women indicated most pregnant women use the internet as their sole nutrition information source. Other less common information sources included primary care physicians, gynecologists and midwives, and books. Pregnant women searched also in books or the internet, while women trying to conceive were more likely to ask their physicians and gynecologists for information. Common nutrition topics searched for included fats, juice, bread, raw meat and cheese, fish, herbs and spices, and fresh food. A 2017 Canadian study reported that 68% of pregnant women hadn’t discussed weight gain with their physicians and 54% had not discussed nutrition.[16] This was attributed to a lack of time and resources to provide education in

a healthcare setting. The internet (73%) and healthcare providers (62.2%) were cited by women as top sources of nutrition information.

Knowledge of weight gain guidelines and nutrition recommendations is an influential factor in making health related behavior changes.[24] Nutrition knowledge and application of that knowledge is low among pregnant populations. A 2016 study indicated that 80% of women of childbearing age do not eat recommended amounts of fruits, vegetables, whole grains, or milk and that 97% reported consuming excess calories from solid fats and added sugars.[25] An Australian study assessed what women knew about nutrition recommendations and found that most were aware of the need for folic acid supplementation, the risks of consuming mercury or listeria, and to avoid alcohol during pregnancy.[24] However, the same women displayed low nutrition knowledge and were generally unaware of weight gain guidelines, when to supplement iodine, how much, when, and why to supplement folic acid, and what foods contained mercury or where at risk for listeria contamination. Pregnant women tend to gain unnecessary amounts of weight during gestation, and 30-50% report not having discussed appropriate pregnancy weight gain with their doctors.[25] Excess weight gain during pregnancy is a strong indicator of continued overweight even 15 years after birth.[26]

It is very common for women to seek nutrition information on the internet, though this information is not always reliable or updated, and women do not always consider it a trustworthy source.[27] Other common sources of information include books and magazines, friends and family, midwives, OBGYNs, and primary care doctors. [24,27,28,29] Registered dietitians or academic publications are not commonly used resources.[29,30] In a study of patients at their OBGYN appointments, only 2% of women considered their primary care physician to be the most important information source for diet concerns during pregnancy.[28]

Primary care physicians are seen frequently for checkups during pregnancy and are one of the most common sources of nutrition counseling. Therefore, it is important to understand what topics doctors discuss with their pregnant patients and where that information is sourced. Women trust and value advice from their PCP, but often feel confused by their recommendations or that their recommendations are vague and conflict with other sources.[25]

A qualitative study of PCPs and midwives found that PCPs were giving weight gain advice that did not align with IOM guidelines (15-88%) or did not account for pre-pregnancy BMI (64%).[25] Only half of the women in this study reported being given calorie recommendations for daily energy needs. Many PCPs do not consider weight gain to be an issue to address until after a woman has gained more than her recommended weight.[31] They also did not consider their advice to have much influence on a patient's actual behaviors and cited many other factors that take precedence. Despite a lack of confidence in their ability to provide effective nutrition and weight gain counseling to pregnant women, PCPs are still reluctant to refer to Registered Dietitians. They often feel like their patients cannot afford or access care from an RD and are unaware of the benefits and efficacy of counseling from an RD.[31]

In two separate Australian studies, only 11 and 31% of pregnant women reported being seen by an RD.[32,33] Most of those women were referred to an RD because they had previous health conditions or pregnancy complications that required specialized care. RDs have more time than PCPs to discuss nutrition and are qualified to counsel women by identifying and addressing individual's barriers to healthy lifestyle changes. RDs are also licensed to provide medical nutrition therapy to mothers with eating disorders, pre-existing conditions, multiple fetuses, and obesity.[18] They are knowledgeable regarding current guidelines and recommendations for nutrition practice and weight gain during pregnancy. Cochrane Reviews also support the

beneficence of nutrition counseling and therapy during pregnancy.[18] A systematic evidence review from the Agency for Healthcare Research and Quality stated that nutrition support programs for pregnant women are associated with improved maternal and birth outcomes.[34]

A woman's nutrition status and dietary behaviors significantly affect birth and health outcomes for her child through epigenetic alterations. Nutrition status in American pregnant women is difficult to assess, and current research indicates confusion and inadequate diet quality among pregnant women. Lack of awareness and sufficient nutrition education during pregnancy results in dietary guidelines not being met. This study attempts to fill a gap in current literature by reporting the nutrition knowledge and behaviors of pregnant women from the perspective of nutrition professionals in North Carolina.

Chapter III

NUTRITION PRACTITIONER'S PERSPECTIVE OF THE NUTRITION KNOWLEDGE AND BEHAVIORS OF PREGNANT PATIENTS

Formatted to meet submission requirements for the *Journal of Maternal and Child Health*.

Abstract

Background: Women are more aware of nutrition during pregnancy but may lack access to reliable information.[27] Prenatal counseling from a Registered Dietitian is associated with improved pregnancy outcomes.[35] The objective of this study was to address inadequate diet quality among rural pregnant women by surveying nutrition professionals regarding their delivery of nutrition education to this population. Insight on these topics from a practitioner viewpoint will help to expose gaps in nutrition care and current knowledge. *Subjects and Method*s: North Carolina nutrition professionals (N=73) working with pregnant women were contacted via email and asked to complete an online survey about their provision of nutrition services to pregnant clients. *Results:* Respondents named cost (91%, n=58) and lack of time to cook (83%, n=55) as the most influential barriers their clients face when attempting to make dietary changes. The topics most asked about by clients were the same topics professionals thought clients needed more guidance on, such as appropriate weight gain (69%, n=50), lactation (63%, n=45), and general healthy nutrition for pregnancy (57%, n=41). Professionals cited pamphlets (97%, n=62), posters (66%, n=41), telehealth counseling (42%, n=27) and texting (38%, n=24) as potentially well accepted education methods. *Conclusions:* Educational interventions designed for rural pregnant women should teach general healthy nutrition and appropriate weight gain while providing guidance on time and cost-efficient approaches. When

possible, delivering information through technology could be an effective, convenient way for nutrition professionals to engage clients.

Key Words: pregnancy nutrition; pregnant; maternal health; nutrition education

Introduction

The key to prevention of chronic disease and obesity risks may begin in prenatal health care and prevention. The timing of influential events, especially early life factors like the fetal environment, are hypothesized to have significant effects in fetal development and outcomes in later life. Due to this, investing in prenatal and maternal care, and targeting prenatal and maternal health interventions to prevent development of chronic disease across the lifespan is warranted.

Research has indicated that women who are trying to conceive or are already pregnant are more aware of their diets and are motivated to make healthy behavior changes for the sake of their children.[27,35] This time of willingness to learn and apply health knowledge is advantageous for health professionals and should be applied in practice. Future interventions in nutrition education and counseling should begin with an assessment of women's diet and health behaviors during pregnancy. What information do women desire and need, what barriers prevent them from applying this knowledge, and what education materials do they prefer?

Background

Nutrition plays a critical role in fetal development and birth outcomes. Inadequate intakes of key nutrients for pregnancy are common among American women of childbearing age, including folic acid, iron, and vitamin D.[30] Access to reliable and safe nutrition education and care is pivotal to health outcomes for mother and baby. However, women may receive limited nutrition information from their primary care physician (PCP), and unless they are considered high-risk with complications like gestational diabetes, they may never be referred to education

and care with nutrition professionals like Registered Dietitian Nutritionists (RDNs). Previous studies have indicated that women lack adequate knowledge of nutrition needs during pregnancy and may lack access to reliable nutrition information.[23,33] Studies have indicated that while women are generally more aware of nutrition during pregnancy, they lack the resources to obtain reliable information or make healthy choices.[16,27]

Research from the US is limited, but data from women in other higher income countries have indicated that the internet (73%) and healthcare providers (62.2%) are top sources of nutrition information.[27] In a study among Australian women, 25% reported feeling inadequately educated on diet during pregnancy and didn't always trust the information they researched online. RDNs are not commonly used resources.[17] PCPs are seen frequently for checkups during pregnancy and are one of the most common sources of nutrition counseling. Women trust and value advice from their PCP, but often feel confused by their recommendations or find their recommendations vague and conflicting with other sources.[16]

A 2014 study surveying PCPs reported that they did not feel confident providing nutrition education for their pregnant clients, but were still reluctant to refer to RDNs.[28] RDNs often have more time than PCPs to discuss nutrition status and barriers to making healthy changes, and counseling from an RDN in prenatal programs is associated with improved pregnancy outcomes.[18] PCPs are more inclined to refer women to RDNs when they have pregnancy induced complications or conditions such as gestational diabetes or preeclampsia.[28] However, there is very limited data examining the provision of nutrition education and care from the perspective of nutrition professionals such as RDNs.

Importance of Nutrition During Pregnancy

Overweight and obesity are prevalent among women of reproductive age.[20] Optimal nutrition and weight status is important prior to conception, as it prevents and lowers risk of developing a multitude of health complications. Pre-pregnancy Body Mass Index (BMI) influences gestational weight gain for over and underweight women. Gaining an appropriate amount of weight during pregnancy as per the Institute of Medicine (IOM) guidelines is influenced in part by maternal nutrition.[17] Maternal obesity rates, and lack of understanding or awareness of weight gain guidelines set by the IOM continue to rise. Healthcare providers must recognize and address this knowledge gap to educate and encourage proper maternal nutrition and weight management.

Table 1. Institute of Medicine Guidelines for Weight Gain in Pregnancy

Pre-Pregnancy BMI Category (BMI=Body Mass Index)	Recommended Total Weight Gain During Pregnancy	
BMI <18.5 Underweight	12.5-18.0 kg	28.0-40.0 lbs
BMI 18.5-24.9 Normal Weight	11.5-16.0 kg	25.0-35.0 lbs
BMI 25.0-29.9 Overweight	7.0-11.5 kg	15.0-25.0 lbs
BMI ≥30 Obese	5.0-9.0 kg	11.0-20.0 lbs

Nutrients of special concern during pregnancy include folate, omega-3 fatty acids, calcium, vitamin D, and iron.[18] Additional special concerns for pregnant populations include vitamin A toxicity, mercury poisoning, substance abuse, and foodborne illness.[16] A systematic review and meta-analysis compared intakes of pregnant women compared with micronutrient recommendations from multiple countries.[16] Even in higher income countries, multiple factors place women at risk for nutrient deficiency, malabsorption, or even excess intake. Key nutrients

below Estimated Average Requirements (EAR) in American women were folate (64% of EAR), iron (72% of EAR), and vitamin D (43% of EAR) even when controlled for socioeconomic status. Similarly, women of childbearing age who were not pregnant had low intakes of these nutrients: folate (55%), iron (45%), vitamin D (58-75%).

A 2013 systematic review evaluated dietary changes in fruits and vegetables, sweet foods, fast and fried foods, beverages, and energy and macronutrients intakes among pregnant women.[21] Most participants reported increased intake of dairy, fruits (85.7% to 94.8%), vegetables (67.6% to 75.4%) and significantly increase dairy intake (1.71 cups to 3.05 cups) during pregnancy. Only one study found that women ate an increased amount of sweets during early and late pregnancy. Two articles indicated no significant difference in fried food intake, but a decrease in fast food intake. Sugary beverage consumption decreased during pregnancy, but women who had high consumption of these beverages had low intakes of fruits and vegetables. Four of five studies noted increased energy intake, and the other reported no change. Women who made dietary changes tended to be older with higher educational attainment.

Nutrition Knowledge and Beliefs of Pregnant Women

Women become more interested in nutrition and health behaviors when they are trying to conceive and once they are pregnant, particularly during the first trimester.[18] A cross-sectional study among Dutch women indicated most pregnant women use the internet as their sole nutrition information source. Other less common information sources included primary care physicians, gynecologists and midwives, and books. Common nutrition topic searches for included fats, juice, bread, raw meat and cheese, fish, herbs and spices, and fresh food. A 2017 study reported that 68% of pregnant women hadn't discussed weight gain with their physicians and 54% had not discussed nutrition.[36] This was attributed to a lack of time and resources to

provide education in a healthcare setting. The internet (73%) and healthcare providers (62.2%) were cited by women as top sources of nutrition information. In one study, only 2% of women considered their primary care physician to be the most important information source for diet concerns during pregnancy.[36]

Healthcare Professionals' Provision of Nutrition Information

Primary care physicians are seen frequently for checkups during pregnancy and are one of the most common sources of nutrition counseling. About one third of PCPs spend 17-24 minutes with each patient.[35] Of this time with their pregnant clients, many PCPs cite lack of time as being a major barrier to providing nutrition advice.[18,37] It is important to understand what topics doctors discuss with their pregnant patients and where that information is sourced. Women trust and value advice from their PCP, but often feel confused by their recommendations or that their recommendations are vague and conflict with other sources.[25]

One study found that PCPs are giving weight gain advice that does not align with IOM guidelines (15-88%) or does not account for pre-pregnancy BMI (64%).[25] Only half of the women in this study reported being given calorie recommendations for daily energy needs. Many PCPs do not consider weight gain to be an issue until after a woman has gained more than recommended.[31] They also did not consider their advice to have much influence on a patient's actual behaviors and cited many other factors that take precedence. Despite a lack of confidence in their ability to provide effective nutrition and weight gain counseling to pregnant women, PCPs are still reluctant to refer to Registered Dietitian Nutritionists. They often believe that their patients cannot afford or access care from an RDN and are unaware of the benefits and efficacy of counseling from an RDN.[31]

In two separate Australian studies, only 11 and 31% of pregnant women reported being seen by an RDN.[33,37] Most of those women were only referred to an RDN because they had previous health conditions or pregnancy complications like gestational diabetes or preeclampsia that required specialized care. RDNs have more time than PCPs to discuss nutrition status and barriers to making healthy changes, and counseling from an RDN in prenatal programs is associated with improved pregnancy outcomes. Cochrane Reviews also support the beneficence of nutrition counseling and therapy during pregnancy.[18] The Evidence Analysis Library published by the Academy of Nutrition and Dietetics indicates strong supporting evidence that overweight and obese women receiving medical nutrition therapy from an RD had lower gestational weight gain than those in a control group.[37]

The goals of this study are to 1) assess the amount of time spent and types of resources used by nutrition professionals when providing nutrition education, 2) determine professional's perception of the nutrition behaviors and knowledge of pregnant patients, and 3) determine what education materials professionals use currently, and what materials they believe would be feasible for and acceptable to their patients. The results of this study are intended to inform and guide the development of future educational materials and interventions among pregnant women in North Carolina.

Methods

Study Design

A cross-sectional, exploratory study was first conducted in 2019 in rural counties of western North Carolina to survey nutrition professionals working with pregnant women. The survey was later expanded for distribution via the NC Academy of Nutrition and Dietetics

ListServe. This study was considered exempt and approved by Appalachian State University's Institutional Review Board and was approved by Appalachian Regional Health Care's review board.

Population and Sample

A purposive sampling method was used. Eligible participants were nutrition professionals who interact with pregnant patients in any capacity. Participation was completely voluntary, and no incentives were offered to participants. Respondents who did not indicate serving pregnant women were excluded. Links to the developed surveys were distributed via email and completed using Qualtrics software which automatically stores and organizes responses. Surveys were distributed via a list of practitioner email addresses provided by the local hospital, directors of local health care clinics and health departments, and the North Carolina affiliate of the Academy of Nutrition and Dietetics. Two reminder emails were sent one and two weeks after the initial release of the survey. The email introducing the survey explained the background and goals of the research project, provided researcher contact information, and indicated that the survey would take about 10-15 minutes to complete. A consent form and option to affirm or decline participation were placed at the beginning of the online survey.

Study Instruments

Survey questions were developed from previously validated surveys and designed to assess the amount of time spent and types of resources used by professionals when providing nutrition education and determine practitioner's perception of the nutrition behaviors and knowledge of pregnant patients. The survey was reviewed and critiqued by seven independent experts in the fields of health and nutrition to strengthen content validity.

The 24-item survey included Likert scale type and multiple-choice questions. All open ended, multiple choice questions provided an "other," write in option to assure that practitioner's experiences were wholly represented.

Information was acquired on the demographics of professionals and their workplaces. Respondents were asked to identify topics they thought patients wanted or lacked education on. Barriers to the delivery and implementation of nutrition education and behaviors were noted. Times were listed in 15-minute increments for RDNs in accordance with standard procedures for billing for RDN services.

Data Analysis

Responses were automatically recorded and stored in a Qualtrics database. All responses were encrypted and anonymized. Surveys were distributed in January 2019 and remain open. Statistical analysis of data was done using the IBM Statistical Package for the Social Science 25 (SPSS). Descriptives were run and the Pearson Correlation test was used to analyze the data with significance set at p= .05.

Results

Characteristics of professionals

Respondents to the survey (N=73) were all females and included Registered Dietitians (n=67), Dietetic Technicians, dietetic interns, and nutritionists. Half of the respondents were between the ages of 40-59 years and had been practicing in nutrition for more than a decade. Nutrition professionals serving in rural counties were less than a third of the sample (29%, n=21). The most common workplace among participants was a non-profit or federally qualified health center (62%, n=44) while others worked within privately owned healthcare systems (34%,

n=24), in private practice (10%, n=7), or other settings (4%, n=3). A large majority of respondents agreed or strongly agreed that they were comfortable (98%, n=62) and prepared (95%, n=60) to provide nutrition education to pregnant women (Table 1). Nutrition professionals were also familiar with the IOM recommendations for weight gain in pregnancy (97%, n=61) and the Dietary Guidelines for Americans 2020 for pregnant populations (84%, n=54).

Table 2. Nutrition Professionals Knowledge and Confidence in Nutrition Information and Guidelines for Pregnancy, "Please note the extent to which you agree or disagree with the following statements."

	I feel comfortable providing nutrition education to pregnant women?		I feel prepared to provide nutrition education to pregnant patients?		I am familiar with DGA 2020 for pregnancy patients?		I am familiar with IOM recommendations for pregnancy weight gain?	
strongly disagree	1	2%	1	2%	0	0%	0	0%
disagree	1	2%	0	0%	4	6%	1	2%
neutral	0	0%	2	3%	5	8%	1	2%
agree	20	31%	16	25%	27	42%	18	28%
strongly agree	42	66%	45	70%	28	44%	44	69%

Identified needs of pregnant clients

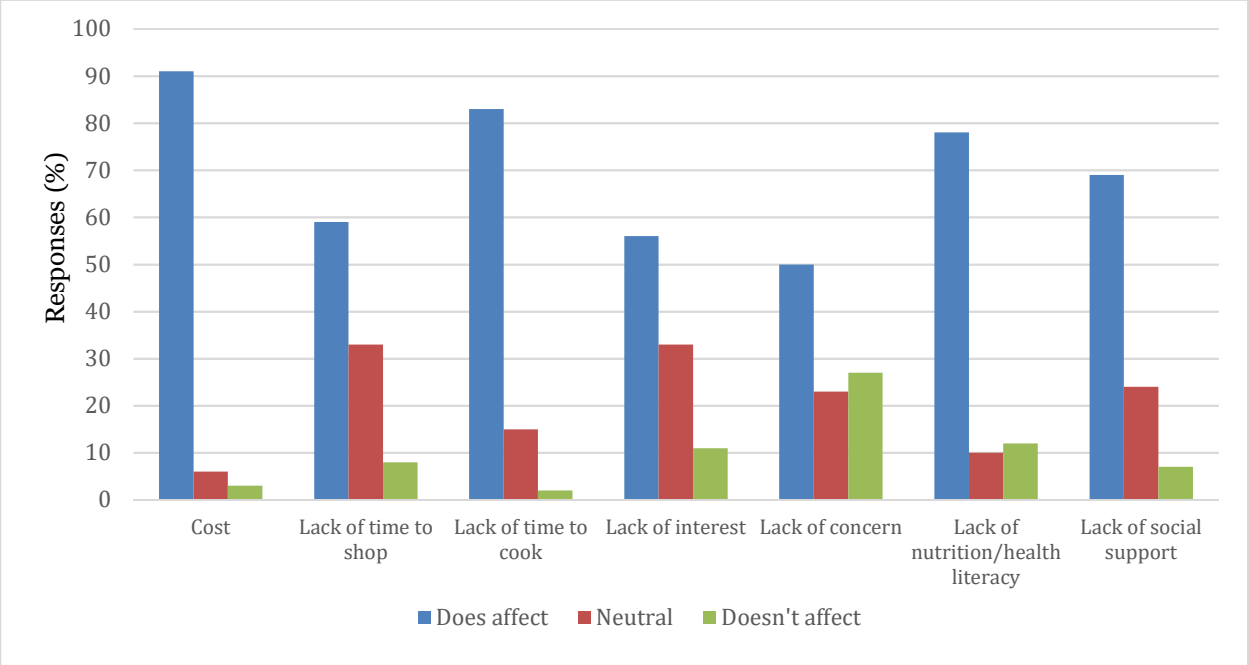
Professionals (N=73) were given a list of nutrition related topics and asked to indicate which topics were most asked about by patients. Using the same list, professionals chose what topics their patients most need information about. The most inquired about topics were weight gain (76%, n=55), general healthy nutrition (72%, n=52), and lactation (57%, n=41). These three topics were also considered by respondents to be what patients most needed information about (69%, n=50; 57%, n=41; and 63%, n=45 respectively). Other topics patients inquired most about were macronutrients (40%, n=29) and supplements (35%, n=25). Additional topics patients needed information or education on were micronutrients (49%, n=36) and food safety (46%,

n=33). An “other” write-in option was also provided. The most frequent responses in this option were gestational diabetes (n=6) and the effects of recreational drug use (n=2).

Identified barriers to improved nutrition

Professionals (N=69) noted cost (91%, n=58), lack of time to cook (83%, n=55), and lack of nutrition and health literacy (78%, n=53) as being the barriers that most affect their patient’s abilities to make healthy choices (Figure 1). As far as barriers to providing nutrition education, two-thirds of respondents indicated that client compliance (65%, n=42) and interest (66%, n=43) affected their ability to provide effective counseling. Forty percent of respondents noted time spent with clients as being a barrier to practice. The average amount of time professionals spent with patients discussing nutrition was 16-30 minutes (42%, n=24). Cost and compensation (25%, n=16) and billing or staffing for billing (11%, n=7) were the least important barriers. No significant difference was found between rural and urban nutrition professionals and their identified barriers in providing nutrition education. A strong, positive correlation existed between professionals who identified client compliance and client interest as being barriers to nutrition education (R=.84, p=.000). Time and client compliance were moderately correlated (R=.593, p=.000).

Figure 1: Barriers Patients Face to Making Healthy Choices and Changes



Nutrition education materials

Nearly all professionals (N=64) said that handouts were used as education materials in their workplace. The second most commonly used education materials were websites (58%, n= 37) and books/magazines (33%, n=21). Professionals felt that written materials like pamphlets (97%, n=62) and posters (66%, n=41), as well as technology related methods like telehealth counseling (42%, n=27) and texting notifications (38%, n=24) might be potentially acceptable avenues of providing nutrition information to clients. Additionally, noted via the write-in option were websites (n=2) and podcasts (n=1).

Discussion

The objectives of this study were to survey nutrition professionals regarding their delivery and knowledge of nutrition education for pregnant women and determine what methods and resources may be most effectively used in future educational interventions for this

population. Currently, most research in this area has focused on the provision of nutrition education and information by PCPs. However, there is a lack of literature describing the full role of nutrition professionals and how they provide education and counseling for pregnant clients, especially from the perspective of the nutrition professionals themselves.

Multiple studies surveying healthcare professionals, including a 2014 systematic review of nutrition advice during pregnancy, reported that respondents indicated perceived lack of patient interest, lack of time, and lack of sufficient nutrition knowledge among PCPs as being barriers to providing women with nutrition and diet information.[28]In this study, client interest and compliance were the highest reported barriers to providing nutrition education. There is potential for addressing these issues if client preferences of nutrition topics and education materials are recognized and used in effective ways. Time continues to be a barrier to all healthcare professionals when providing nutrition education and counseling.[39] Our respondents cited an average of 16-30 minutes spent discussing nutrition with patients, and 40% agreed that available time spent with patients was a barrier to providing nutrition care.

Because this survey was intended for nutrition professionals rather than PCPs, lack of sufficient nutrition knowledge or training was not an identified barrier to practice. Nutrition professionals like RDNs, which made up 92% of our sample, are experts in diet throughout the lifespan. Within our sample were many experienced RDNs and nutrition professionals, as more than half indicated practicing nutrition for more than a decade. A large majority of our respondents indicated feeling comfortable and well prepared in providing nutrition education to pregnant women.

Nutrition professional's perspectives of the knowledge requirements of patients were the same as the topics most inquired about by their patients. Education on weight gain in pregnancy

and general healthy nutrition specifically could make an impact on a mother's health during and after a pregnancy. Nutrition requirements for lactation are also of concern to professionals and pregnant patients. This time period significantly contributes to the current and future health of both mother and baby. In the U.S., 2015 rates of exclusive breastfeeding at 6 months of age in the U.S. were at 24.9% nationally and 27% in North Carolina, providing breastfeeding education may have significant impacts on increasing that rate to WHO objective of 50% by 2025.[38]

Lack of time to shop and cook, cost, and lack of nutrition and health literacy were all cited by our respondents as barriers impacting their patient's abilities to make healthy dietary changes. These results are consistent with other studies surveying PCPs and pregnant women who also indicate cost, lack of time, and lower education and income level as being barriers. Also consistent with other studies surveying patient preferences, professionals indicated pamphlets as a popularly used and preferred educational resource.[38] Lucas et al.'s systematic review found preferences of pregnant women to include one on one counseling with individualized advice and pamphlets with simplified information and rationales provided.[27] Authors of this review suggest a list of reputable websites as being potentially useful to patients as well. Education materials designed by nutrition professionals that utilize technology (videos, texts, podcasts, websites) may also increase client compliance and interest, especially when addressing nutrition topics of importance to them. Kolasa and Rickett assert that while there is no lack of nutrition education materials and resources available to professionals, individualized materials and counseling may be required to make an impact on patients.[40]

Limitations

The survey was originally intended to be of use in rural counties by rural professionals and individuals. Due to a low response rate, the survey was expanded to include nutrition

professionals from all of North Carolina. Because a larger number of respondents worked in non-rural areas (n=51), the distribution of rural to non-rural professionals was not normal. This may have influenced the lack of significant results found between rural and non-rural responses. In hindsight following data collection, some of the question formats may have limited responses for participants. Future surveys will use a "select all that apply" option when possible to ensure that respondents are not limited to their top choice.

Conclusion

This study provides a nutrition practitioner's perspective to the limited literature on nutrition education for pregnant women. Prior research has focused on nutrition care and counseling provided by PCPs.[27,39] Further research into nutrition practitioner and patient preferences and needs are warranted to maximize effective nutrition care.[27,28] Educational interventions designed for pregnant women should teach general healthy nutrition, nutrition for lactation, and appropriate weight gain while providing guidance on time and cost-efficient approaches to dietary change. When possible, delivering information through technology could be an effective, convenient way for nutrition professionals to engage clients.

Financial Support and Sponsorship

None.

Acknowledgement

Thanks to all study participants, our counterpart graduate researcher Sarah Stroup, the Hope Clinic, Watauga Co. Health Department, and Harmony Center for distributing our survey.

Conflict of Interest

The authors of this study have no conflicting affiliation or involvement with institutions that have financial or non-financial interest in the topics and materials discussed in this manuscript.

Chapter IV Epilogue

Lessons learned

Though the reach of the survey was expanded state-wide including rural and urban counties to encourage higher participation rates, in hindsight, it would have been beneficial to ask more questions pertaining to common health barriers faced by rural populations. Such questions may have included access to transportation and primary care physicians, insurance coverage, cost of healthcare and medications, knowledge of diet and weight guidelines in pregnancy, use of and eligibility for SNAP/WIC, and education and literacy levels. Gaining this data could contribute to improved understanding of rural patients' concerns, open dialogue on how to overcome such barriers and guide more targeted educational interventions for rural populations.

The nutrition practitioner survey discussed in this paper has an almost identical counterpart which we developed and intended for non-nutrition professionals (MDs, NPs, DOs, RNs, etc.). The initial goal for this research project was to compare responses of non-nutrition to nutrition professionals. However, multiple factors contributed to a low response rate from non-nutrition professionals, ultimately preventing accurate and fair statistical comparison of the two data sets. Moving forward, we would like to reach more non-nutrition professionals with this survey and compare results between the two respondent groups. Many pregnant women do not have access to a nutrition professional before, during or after pregnancy, but will see their PCP regularly during gestation. This could be a critical point to reach pregnant women with accurate nutrition information.

Future Research Implications

Future research regarding the provision of nutrition education and care for pregnant women should provide a deeper understanding of this population's needs. Qualitative studies involving interviews and focus groups with dietitians and nutritionists that serve women in pregnancy would allow for this deeper understanding. In particular, these studies could be conducted among nutrition professionals working with specific subgroups of pregnant women (rural, urban, low income, women with pregnancy induced health complications etc.) to further allow the creation of targeted, appropriate education materials and strategies.

How can referrals to and reimbursement for nutrition professional for education during pregnancy become more accessible? Collaboration with other integral members of a pregnant woman's healthcare team including primary care physicians, midwives, and obstetricians, is essential to building trust and rapport and increasing referrals for nutrition services. Support from the interdisciplinary team and recognition of the value of nutrition counseling on health outcomes for pregnant women is essential to the care of these patients and their babies. Research that adds to the conversation about nutrition care and support during pregnancy should consider input from the full interdisciplinary team which will guide future interventions and education for this population.

References

1. Cheng T, Solomon B. Translating life course theory to clinical practice to address health disparities. *Matern Child Health J*. 2014;18(2):389-395. doi:10.1007/s10995-013-1279-9.

2. Braveman AP. Health Disparities Beginning in childhood: A life-course perspective. *pediatrics*. 2009;124(November). doi:10.1542/peds.2009-1100.

3. Maternal and Child Health Bureau. Rethinking MCH: The life course model as an organizing framework. *US Dep Heal Hum Serv*. 2010:21. https://www.hrsa.gov/ourstories/mchb75th/images/rethinkingmch.pdf.

4. Hanson MA, Gluckman PD. Developmental origins of health and disease - Global public health implications. *Best Pract Res Clin Obstet Gynaecol*. 2015;29(1):24-31. doi:10.1016/j.bpobgyn.2014.06.007.

5. Eriksson JG, Forsen TJ. Childhood growth and coronary heart disease in later life. *Ann Med*. 2002;34(3):157-161. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=12173685.

6. Bale T, Baram T, Brown A, et al. Early life programming and neurodevelopmental disorders. *Biol Psychiatry*. 2011;68(4):314-319. doi:10.1016/j.biopsych.2010.05.028.

7. Nugent BM, Bale TL. The omniscient placenta: Metabolic and epigenetic regulation of fetal programming. *Front Neuroendocrinol*. 2015;39:28-37. doi:10.1016/j.yfrne.2015.09.001.

8. Harding JE. The nutritional basis of the fetal origins of adult disease. *Int J Epidemiol*. 2001;30(1):15-23. doi:10.1093/ije/30.1.15.

9. Marciniak A, Patro-Małysza J, Kimber-Trojnar Ż, et al. Fetal programming of the metabolic syndrome. *Taiwan J Obstet Gynecol*. 2017;56(2):133-138. doi:10.1016/j.tjog.2017.01.001.

10. Soubry A, Murphy S, Wang F, et al. Newborns of obese parents have altered DNA methylation patterns at imprinted genes. *Int J Obes*. 2015. doi:10.1038/ijo.2013.193.

11. Guéant J, Namour F, Guéant-Rodriguez R, Daval J. Folate and fetal programming: A play in epigenomics? *Trends Endocrinol Metab*. 2013;24(6):279-289. doi:10.1016/j.tem.2013.01.010.

12. Chmurzynska A. Fetal programming: Link between early nutrition, DNA methylation, and complex diseases. *Nutr Rev*. 2010;68(2):87-98. doi:10.1111/j.1753-4887.2009.00265.

13. Symonds M, Gopalakrishnan G, Bispham J, et al. Maternal nutrient restriction during placental growth, programming of fetal adiposity and juvenile blood pressure control. *Arch Physiol Biochem*. 2003;111(1):45-52. doi:10.1076/apab.111.1.45.15141.

14. Chalovich J, Eisenberg E. Obesity in pregnancy stimulates macrophage accumulation and inflammation in the placenta. *NIH Public Access*. 2013;31(3):477-479.

doi:10.1016/j.immuni.2010.12.017.

15. Finer S. Fetal programming via maternal diabetes: The controversy continues. *Diabet Med*. 2015;32(3):291-294. doi:10.1111/dme.12675.

16. Blondin JH, LoGiudice JA. Pregnant women's knowledge and awareness of nutrition. *Appl Nurs Res*. 2018;39:167-174. doi:10.1016/j.apnr.2017.11.020.

17. Cox S, Franklin B, Jones A, et al. Weight gain during pregnancy. *J Midwifery Womens Health*. 2013;48(3):229-230. doi:10.2105/AJPH.76.12.1390.

18. Cox JT, Phelan ST. Nutrition during pregnancy. *Obstet Gynecol Clin North Am*. 2008;35:369-383. doi:10.1016/j.ogc.2008.04.001.

19. Alavi N, Haley S, Chow K, Mcdonald S. Comparison of national gestational weight gain guidelines and energy intake recommendations. *Obes Rev*. 2013;14(1):68-85. doi:10.1111/j.1467-789X.2012.01059.

20. Ho A, Flynn A, Pasupathy D. Nutrition in pregnancy. *Obstet Gynaecol Reprod Med*. 2016;26(9):259-264. doi:10.1016/j.ogrm.2016.06.005

21. Blumfield M, Hure AJ, Macdonald-Wicks L, Smith R, Collins C. A systematic review and meta-analysis of micronutrient intakes during pregnancy in developed countries. *Nutr Rev*. 2013;71(2):118-132. doi:10.1111/nure.12003.

22. Bodnar L, Simhan H, Parker C, et al. Racial or ethnic and socioeconomic inequalities in adherence to national dietary guidance in a large cohort of us pregnant women. *J Acad Nutr Diet*. 2017;117:867-877. doi:10.1016/j.jand.2017.01.016.

23. Szwajcer E, Hiddink G, Maas L, Koelen M, van Woerkum C. Nutrition-related information-seeking behaviours of women trying to conceive and pregnant women: Evidence for the life course perspective. *Fam Pract*. 2009;25(SUPPL. 1):99-104. doi:10.1093/fampra/cmn077.

24. Lee A, Newton M, Radcliffe J, Belski R. Pregnancy nutrition knowledge and experiences of pregnant women and antenatal care clinicians: A mixed methods approach. *Women and Birth*. 2018;31:269-277. doi:10.1016/j.wombi.2017.10.010.

25. Whitaker, K, Wilcox, S, Liu, J, Blair, S, Pate R. Patient and provider perceptions of weight gain, physical activity and nutrition counseling during pregnancy: a qualitative study Kara. *Women's Heal Issues*. 2017;26(1):116-122. doi:10.1016/j.whi.2015.10.007.

26. Hillier SE, Olander EK. Women's dietary changes before and during pregnancy: A systematic review. *Midwifery*. 2017. doi:10.1016/j.midw.2017.01.014.

27. Lucas C, Charlton KE, Yeatman H. Nutrition advice during pregnancy: Do women receive it and can health professionals provide it? *Matern Child Health J*. 2014;18(10):2465-2478. doi:10.1007/s10995-014-1485-0.

28. May L, Suminski R, Berry A, Linklater E, Jahnke S. Diet and pregnancy: Health-care providers and patient behaviors. *J Perinat Educ*. 2014;23(1):50-57. doi:http://dx.doi.org/10.1891/1058-1243.23.1.50.

29. Kennedy R, Mullaney L, Reynolds C, et al. Preferences of women for web-based nutritional information in pregnancy. *Public Health*. 2017;143:71-77. doi:10.1016/j.puhe.2016.10.028.

30. Lim Z, Wong J, Lim P. Knowledge of nutrition during pregnancy and associated factors among antenatal mothers. *Int J Public Heal Clin Sci*. 2018;5(1):117-128.

31. Chang T, Llanes M, Gold K, Fetters M. Perspectives about and approaches to weight gain in pregnancy: A qualitative study of physicians and nurse midwives. *BMC Pregnancy Childbirth*. 2013;13. doi:10.1186/1471-2393-13-47.

32. Lee A, Belski R, Radcliffe J, Newton M. What do pregnant women know about the healthy eating guidelines for pregnancy? A web-based questionnaire. *Matern Child Health J*. 2016;20(10):2179-2188. doi:10.1007/s10995-016-2071-4.

33. Bookari K, Yeatman H, Williamson M. Falling short of dietary guidelines – What do Australian pregnant women really know? A cross sectional study. *Women and Birth*. 2017;30:9-17. doi:10.1016/j.wombi.2016.05.010.

34. Ammerman A, Pignone M, Fernandez L, et al. Counseling to promote a healthy diet. *Agency Healthc Res Qual*. 2002;18:145. http://www.crd.york.ac.uk/CRDWeb/ShowRecord.asp?ID=12003008501.

35. Amount of time U.S. primary care physicians spent with each patient as of 2018. Statistica. https://www.statista.com/statistics/250219/us-physicians-opinion-about-their-compensation/. Published 2018. Accessed May 16, 2018.

36. Heller Blondin J, LoGiudice JA. Pregnant women's knowledge and awareness of nutrition. *Appl Nurs Res*. 2018;39:167-174. doi:10.1016/j.apnr.2017.11.020.

37. Academy of Nutrition and Dietetics. Malnutrition in pregnancy (MIP) systematic review. Evidence Analysis Library. https://www.andeal.org/topic.cfm?menu=5529&cat=5620. Published 2018. Accessed May 20, 2019.

38. CDC. Breastfeeding Report Card. https://www.cdc.gov/breastfeeding/data/reportcard.htm. Published 2019.

39. Kenner MM, Taylor ML, Dunn PC, Gruchow HW, Kolasa K. Primary care providers need a variety of nutrition and wellness patient education materials. *J Am Diet Assoc*. 1999;99(4):462-466. doi:10.1016/S0002-8223(99)00113-3.

40. Kolasa K, Rickett, K. Developments and challenges in family practice nutrition education for residents and practicing. *Eur J Clin Nutr*. 1999;53(5):S89. http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=1998794&site=ehost-live.

Appendix

Survey for Registered Dietitians on Nutrition Education for Pregnant Clients

Hello!

You are invited to participate in a project entitled, Practitioner Perspectives of the Health Knowledge and Behaviors of Pregnant Clients. This study is being conducted by Dr. Danielle Nunnery at Appalachian State University's Departments of Health and Exercise and Nutrition and Health Care Management. Please feel free to contact the investigator if you have questions or would like to discuss the survey further nunnerydl@appstate.edu.

The purpose of this study is to determine the nutrition behaviors and knowledge among pregnant women living in rural North Carolina as well as the education and counseling they receive during pregnancy. Your input in this survey will help us learn how to discuss or provide nutrition education with pregnant patients in the future.

Your participation in this research project is completely voluntary. You may decline altogether, or leave blank any questions you don't wish to answer. Your responses will remain confidential and anonymous. Data from this research will be securely kept and reported only as a collective combined total. No one other than the researchers at Appalachian State University will know your individual answers to this questionnaire.

Do you consent to participate in this survey?

O I consent

O I do not consent (if you do not consent, you are finished with the survey)

In what county do you currently work? If you serve more than one county please list all.

_____

Which of the following best describes where you work?

O Owned by or affiliated with a larger health care system

O Private practice

O Public Health Clinic (non-profit, FQHC, etc.)

O Other (please specify) _____

What types of insurance does your practice accept? Mark all that apply.

- ☐ Private
- ☐ Medicare
- ☐ Medicaid
- ☐ Tricare (military)
- ☐ Self-pay
- ☐ Other (please specify) _____

What is your age?

- O <30
- O 30-39
- O 40-49
- O 50-59
- O 60-69
- O 70+

What is your gender?

- O Male

O Female

O Prefer not to say

How many years have you been in practice?

O <5

O 5-9

O 10-15

O 16-20

O 20+

How many years have you worked at your current employer?

O <5

O 5-9

O 10-15

O 16-20

O 20+

What are your credentials?

O RD/RDN

O DTR/NDTR

O CDE

O Other (please specify) _____

Do you hold any additional certifications? Please list them.

O Yes _____

O No additional certifications held

Please consider your pregnant patients exclusively when answering the remainder of the questions.

What nutrition topics do your pregnant patients typically request information about? Mark all that apply.

☐ Supplements (herbals, complementary alternative medicine)

☐ Micronutrient needs during pregnancy (folate, iron, calcium, vitamins and minerals)

☐ Macronutrient content of diet (high or low carb, fat, protein diets)

☐ General healthy diet for pregnancy

☐ Food safety/Bacterial or viral foodborne illness

☐ Lactation

☐ Weight gain during pregnancy

☐ Alcohol consumption

- [ ] Drug-nutrient interactions, overall drug interactions
- [ ] Food preparation and cooking
- [ ] Other (please specify) _____
- [ ] They do not request nutrition information

On what topics do you think your patients need the most education? Mark all that apply.

- [ ] Supplements (herbals, complementary alternative medicine)
- [ ] Micronutrient needs during pregnancy (folate, iron, calcium, vitamins and minerals)
- [ ] Macronutrient content of diet (high or low carb, fat, protein diets)
- [ ] General healthy diet for pregnancy
- [ ] Food safety/Bacterial or viral foodborne illness
- [ ] Lactation
- [ ] Weight gain during pregnancy
- [ ] Alcohol consumption
- [ ] Drug-nutrient interactions, overall drug interactions
- [ ] Other (please specify) _____

Please indicate the extent to which you agree or disagree with the following statements.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The pregnant women served by this clinic are willing to make diet ad behavior changes to ensure a healthy pregnancy and baby.	O	O	O	O	O
The pregnant women served by this clinic are able to make diet and behavior changes to ensure a healthy pregnancy and baby.	O	O	O	O	O
The pregnant women served by this clinic are interested in receiving nutrition education.	O	O	O	O	O

Do you use any kind of nutrition screening or assessment tools with your pregnant patients? Mark all that apply.

- ☐ Nutrition Focused Physical Exam
- ☐ Gestational weight gain
- ☐ Birth weight of infant (growth charts)
- ☐ Blood pressure
- ☐ Blood glucose or HbA1c
- ☐ Lipid panel

☐ None of the above

☐ Other (please specify) _____

Consider the following challenges. Please note the extent to which you perceive them to affect your patient's abilities to make nutrition related behavior changes.

	Does not affect	Neutral	Does affect
Cost	O	O	O
Lack of time to shop	O	O	O
Lack of time to cook healthful meals	O	O	O
Lack of interest	O	O	O
Lack of concern	O	O	O
Lack of nutrition and health literacy	O	O	O
Lack of social support	O	O	O

Do you currently bill for any of the following nutrition related diagnoses when working with pregnant women? Mark all that apply.

- [ ] Type 1 Diabetes
- [ ] Type 2 Diabetes
- [ ] Gestational Diabetes
- [ ] Chronic Kidney Disease
- [ ] Hypertension
- [ ] Preeclampsia
- [ ] Eclampsia
- [ ] Cardiovascular Disease
- [ ] Obesity (BMI >30)
- [ ] Underweight (BMI
- [ ] Eating Disorders
- [ ] Iron deficiency anemia
- [ ] HIV/AIDS
- [ ] None of the above apply
- [ ] Other (please specify) _____

How many pregnant patients do you see in an average week? Please indicate an whole number, and estimate as closely as possible.

_____

What percentage of your patients have nutrition related health complications? Please estimate as closely as possible.

_____

Do you coordinate or communicate with patient's primary care providers?

- O Always
- O Sometimes
- O Never

What percentage of your patients receive nutrition education or counseling by someone at your practice, including yourself? Please estimate as closely as possible.

_____%

How long do you typically spend discussing nutrition topics with each patient?

- O Not applicable
- O <15 min
- O 16-30 min
- O 31-45 min
- O 45-60 min
- O 1+ hours

What educational resources do you use or provide to patients when discussing nutrition?

☐ Handouts

☐ Websites to visit

☐ Books/Magazines

☐ Seminars or classes/workshops

☐ Other (please specify) _____

How much do these barriers affect your practice's ability to provide nutrition education and counseling?

	Does not affect	Neutral	Does affect
Cost/compensation	O	O	O
Time spent with client	O	O	O
Client compliance	O	O	O
Client interest	O	O	O
Billing/Staffing for billing	O	O	O

Other (please specify)	O	O	O

Which of the following interventions or resources would be feasible and well accepted by your clients for providing nutrition education? Mark all that apply.

- ☐ Pamphlets/Handouts
- ☐ Posters in waiting area
- ☐ Telehealth counseling
- ☐ Books/Magazines
- ☐ On-site workshops
- ☐ Online seminars
- ☐ Texts about nutrition topics
- ☐ Other (please specify) _____

Please note the extent to which you agree or disagree with the following statements.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I feel comfortable educating patients on most nutrition topics.	O	O	O	O	O

I feel adequately prepared to provide nutrition education to pregnant women.	O	O	O	O	O
I am familiar with the Dietary Guidelines for Americans 2020 and their recommendations for pregnancy.	O	O	O	O	O
I am familiar with the Institute of Medicine recommendations for weight gain during pregnancy.	O	O	O	O	O

Which resources do you use to stay up to date with nutrition topics? Mark all that apply.

- ☐ Discussion with other nutrition professionals
- ☐ Online sources
- ☐ Emails or publications from the Academy of Nutrition and Dietetics
- ☐ Peer-reviewed nutrition journals
- ☐ Continuing education
- ☐ Conferences/seminars
- ☐ Pamplets/handouts
- ☐ Books/magazines

☐ Other (please specify) _____

End of the survey.

VITA

Sydney Van Scyoc was born in Wichita, Kansas. She is the daughter of Tim and Dee Ann Van Scyoc. She earned a Bachelor's of Science in Nutrition from Ouachita Baptist University in Arkadelphia, Arkansas where she first became passionate about rural health and interested in nutrition research. She completed her Dietetic Internship in Wilkesboro, North Carolina and Master's of Science in Nutrition at Appalachian State University. Her professional interests include improving the nutrition status of low-income, rural populations through research, nutrition education and interventions, and local policy change. She plans to enter the field of dietetics by working in a rural setting to encourage and empower individuals, families, and communities to move towards improved health and eating habits.